NASA Glenn Faculty Fellowship Program
Glenn Research Center

Office/Division Name: Human Exploration and Space Operations Project Office and the Propulsion Division

Branch Name: ISS and Human Health Office and Low-Gravity Exploration Technology Branch

Research/Engineering Area / Topic: Soft Matter, Materials and Structures for Extreme Environments

Description of Research/Engineering Work to Be Performed

Brief background and NASA mission/program support

NASA GRC is interested in studying soft matter using 3D microscopy because soft matter materials — such as polymers, colloids, foams, gels, and bio-soft materials — have unique properties that are crucial for space exploration. These materials often exhibit complex behaviors under different environmental conditions, like microgravity, radiation, and temperature fluctuations, which are common in space. Understanding how soft matter behaves in space is important because microgravity environments provide unique opportunities to study soft matter physics. Without Earth's gravitational interference, scientists can observe the intrinsic properties and behaviors of soft materials, leading to new scientific insights that benefit both space and terrestrial applications.

Objective(s) of project

Incorporate 3D microscopy to visualize materials in detail, helping design better materials and systems for future space missions. The faculty will support experimental research in developing optical capabilities for portable and modular 3D microscopy to study soft matter.

Specific faculty assignment

The areas of research will be dependent on the background of the applicant and may include the following:

1. Miniaturization of advanced optical techniques, such as light-sheet microscopy or two-photon excitation, into a compact, portable design. This project would allow researchers to visualize soft materials like gels, polymers, and biological tissues in three dimensions with high resolution across different space research platforms (e.g.- as small as CubeSats).

2. Development of interchangeable optical modules that provide flexibility for different imaging needs — ranging from fluorescence to phase contrast, enabling the study of soft matter's structural and dynamic properties.
3. Development of real-time imaging capabilities for the observation of soft matter behavior under various conditions, such as stress, temperature changes, or chemical interactions.

Expected Outcome(s) from assignment.

1. Identify which optical technique planned to be miniaturized, the soft materials to be studies and/or the research platforms to be used.
2. Summary and outline of plan in the development work for the imaging needs and imaging capabilities of soft matter.

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